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Community-Led Coastal Management in the Gulf of Mottama Project (CLCMGoMP)

Updated situation analysis of the Gulf of Mottama

Based on the rapid socio-ecological assessment

September 2015
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About SDC

The Swiss Agency for Development and Cooperation **(SDC)** a division of the Federal Department of Foreign Affairs (FDFA), is responsible for Switzerland's international cooperation and development program.

The most important areas of work for the SDC are as follows:

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- Humanitarian aid, through the Humanitarian Aid Department and the Swiss Humanitarian Aid Unit (HA/SHA)
- Cooperation with Eastern Europe and the CIS

SDC in Myanmar

SDC partners with both multilateral organizations and government institutions to create long-term, sustainable programs to reduce poverty, strengthen food security, expand economic opportunities for rural and marginalized communities, encourage gender and ethnic equity, while promoting a more active civil society that fosters transition to democracy.

SDC focuses its bilateral interventions in the southeast of Myanmar, namely Mon, Kayin, Kayah States, and east Bago and northern Tanintharyi Regions.

SDC is also a donor member of the Livelihood and Food Security Trust Fund (LIFT).

The Swiss Cooperation Strategy in Myanmar for 2013-2017, outlines four main domains:

- Employment and Vocational Skills Development
- Agriculture and Food Security
- Health, social services and Local Governance
- Peace, Democratization and Protection

Mainstreamed are three priority transversal themes which underpin interventions carried out in the four domain clusters:

- Gender equality
- Good governance
- Climate change and disaster risk reduction

The Community-Led Coastal Management in the Gulf of Mottama Project (CLCMGoMP) contributes to SDCs Agriculture and Food Security (AFS) portfolio.

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About the Community-Led Coastal Management in the Gulf of Mottama Project (CLCMGoMP)

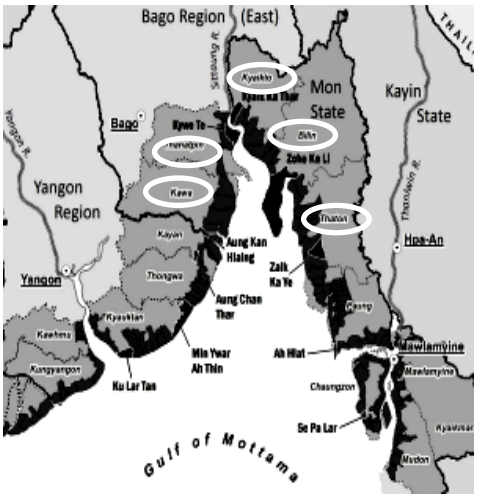
Phase 1 of CLCMGoMP[1] started in February 2015 with a 7-month inception period, and will end mid-April 2018. The project is supported by the Swiss Agency for Development and Cooperation (SDC) and is being implemented by a consortium led by HELVETAS Swiss Intercooperation (HELVETAS), with Network Activities Group (NAG) a local organization and the International Union for Conservation of Nature (IUCN). Phase 1 represents the first phase of what is expected to be a 10-year SDC commitment to the Gulf of Mottama (GoM), highlighting SDCs long-term development cooperation strategy.

The specific project objective is *Vulnerable women and men in targeted coastal areas of the GoM have improved livelihood security through effective fisheries value chain development, livelihoods diversification and equitable and sustainable management of resources.*

The project has three interdependent outcomes, each one facilitated by a consortium partner:

1. Benefits of sustainable fisheries management in the GoM are shared through effective value chains and equitable market access (led by NAG).
2. Vulnerable coastal communities have increased income and resilience through livelihood diversification and improved access to non-fisheries resources (led by HELVETAS).
3. The special habitats of the GoM are sustainably and equitably managed on the basis of scientific evidence through integrated local, regional and national institutions/management bodies (led by IUCN in collaboration with BANCA, the Biodiversity and Nature Conservation Association and Mawlamyine University) including Ramsar site designation.

Building on the designation of GoM as a Ramsar site, the project will support community-led co-management systems for coastal fisheries, improve the fishery value chain, and provide diversified livelihood opportunities to local communities. It will build alliances between community and state-level stakeholders in fisheries, between state and region governments, and with central government for improved management of GoM and its fisheries resources. Ramsar wise use co-management bodies will build on these fishery resource management alliances and platforms. In this first phase, the project will focus on the coastal areas of northern Mon State and eastern Bago Region and will then expand to include Yangon Region.



www.helvetas.org/myanmar

www.nagmyanmar.org

www.iucn.org

[1] https://myanmar.helvetas.org/en/projects/clcmgomp/

1. INTRODUCTION

Receiving large masses of sediments from Ayeyarwady, Sittaung and Thanlwin Rivers, the Gulf of Mottama (GoM) is recognized as the most extensive and most significant intertidal mudflat system in Southeast Asia. It provides ecosystem goods and services to communities living in Mon State, Bago Region and Yangon Region, and supports a variety of aquatic species and wintering shorebirds. Due to difficult access to the area, the Gulf of Mottama (or the Gulf of Martaban) is one of the least studied coasts in the country. Given its significance as wintering ground for the Critically Endangered Spoon-billed sandpiper, the gulf has recently attracted attention from researchers, development partners as well as bird watchers from across the region.

This scoping study is part of inception period of the 10-year Community-Led Coastal Management in the Gulf of Mottama Project (GoMP) supported by the Swiss Agency for Development and Cooperation (SDC). The project is being implemented by a consortium led by HELVETAS with NAG (National Action Group, local NGO) and IUCN. A rapid socio-ecological assessment was conducted by IUCN research team between 6-10 June 2015, with an aim to understand the current fisheries and ecosystem resources as well as socio-economic situation, in order to provide scientific evidence for sustainable and equitable management of special habitats of the GoM. The rapid survey covered six coastal villages in Mon State, Bago Region and Yangon Region. This document provides an overall picture of the gulf, including its biophysical characteristics, socio-economic conditions of coastal population, fishing activities, status of fishery resources, and issues facing sustainable management of fisheries in the gulf, based on latest information from various sources, field assessment and interviews with key stakeholders. It is recommended in this report that various approaches and urgent actions are required to improve local livelihoods, coastal community resilience, and to support the establishment of a collaborative long-term fisheries and coastal ecology in the gulf. The synthesis data from this study will contribute to long-term fisheries assessment and ecological monitoring in the gulf, and also provide the basis for state/region governments in drafting resource management guidelines, and as reference to the Ramsar initiative committee for process of designating the gulf as a wetland of international importance.

2. THE GULF OF MOTTAMA

2.1 Administrative boundaries

Myanmar's coastline can be divided into three coastal regions: the northern Rakhine coastal region in the Bay of Bengal; the central Ayeyarwady coastal region (which includes the Ayeyarwady Delta and the GoM) and the southern Tanintharyi coastal region in the Andaman Sea. The GoM is referred to an area within a straight line between the southern point of Pyapon township in Ayeyarwady Region and the southern point of Mudon Township in Mon State. In this project, the administrative areas of interest are Yangon Region, Bago Region and Mon State (Figure 1). The western coast of the gulf covers Yangon Region townships of Kungyangon, Kawhmu, Kyauktan, Thongwa, and Kayan. The central coast lies in Bago Region townships of Kawa and Thanatpin. The eastern coast includes Mon State townships of Kyaikhto, Bilin, Thaton, Paung, Chaungzon, Mawlamyine, Kyaikmaraw and Mudon. The Mon State area encompasses the entire eastern side of the gulf and includes the prospective Ramsar site based on wetlands around Kyaikto and Bilin in the upper gulf. Of this total length, Mon State hosts the longest coastline and the main city in the gulf, Mawlamyine, which is also the capital of the state.

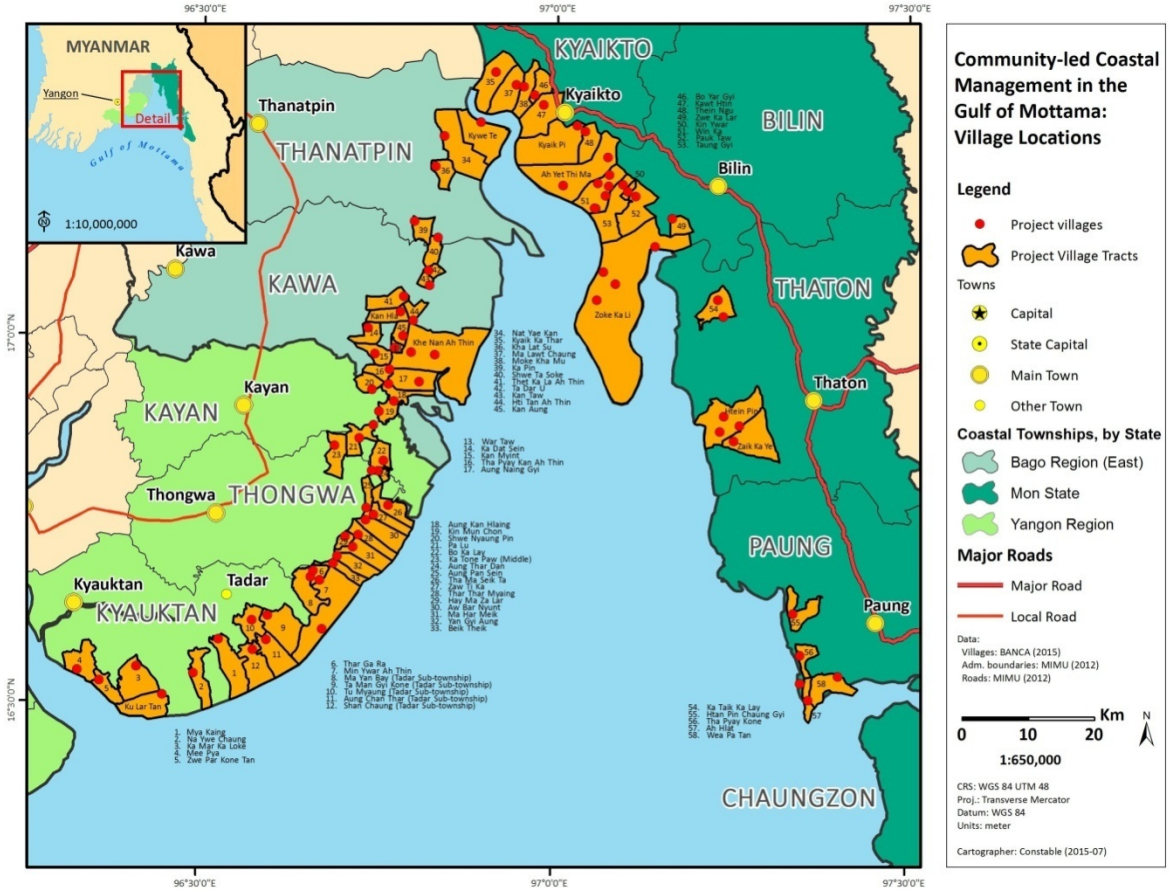


Figure 1 Administrative map of the Gulf of Mottama.

2.2 Geology and bathymetry

The GoM is influenced by seasonal reversal of monsoon winds and coastal currents, periodic tropical cyclones and storm surges, and neo-tectonic activity. Macro-tidal conditions prevailing in the northern Andaman Sea play a major role in redistributing sediments delivered by rivers. Most of the suspended sediment discharge of the Ayeyarwady is transported eastwards by coastal and tidal currents and deposited in the GoM, contributing to the formation of an extensive mud belt (Ramaswamy & Rao, 2014). The Sittaung River has a low annual sediment load, whereas the Thanlwin delivers about 110-180 Mt of sediments annually. In total, the Ayeyarwady, Thanlwin, Sittaung and smaller tributaries deliver an estimated 752 km^3 of water and 370–600 Mt of sediment per year to the gulf (Robinson et al., 2007).

A characteristic feature of the GoM is not only influenced by the river runoff but also greatly affected by tidal system. Notably in the gulf, river discharges do not contribute significant role for the increment in the suspended sediment concentration (SSC) covered area, rather the major change in the SSC is related to the spring tide cycles (MatAmin et al., 2015; Ramaswamy et al., 2004). Tides ranges between 4–7 m (In dian Tide Tables, 2002) with the highest tidal range recorded at the Elephant Point in the western GoM. During spring tide when the tidal range is 6.6 m, the turbid zone covers an area of more than 45,000 km^2 making it one of the largest perennially turbid zones of the world's oceans. During neap tide with tidal range of 2.98 m, the coverage drops to about 15,000 km^2. The edge of the highly turbid zone migrates back-and-forth in sync with every tidal cycle (14 days) by nearly 150 km (www.eosnap.com). See Figure 2 (a) for bathymetric map of the gulf when contour values are in meters, and stippled area denotes area occupied by modern muds (sand < 20%). Figures 2b and 2c show temporal variations in suspended sediment concentration during spring tide (tidal range 6 m) and neap tide (tidal range 2.9 m).

Studies on bathymetry by Ramasamy and Rao of the National Institute of Oceanography supplemented with satellite data and images indicate that the sea floor in the GoM, the surrounding coastal areas and estuaries are covered with silty clays and subject to constant settling and resuspension due to tidal forces. The shallowness (< 30 m deep) of the gulf allows the tidal currents mix the waters and bring the resuspended material to the surface. Beyond a depth of 30 m, the situation changes drastically. Sediments are predominantly sandy, with sand content varying from 61-96%. The gradient of the sea floor increases sharply and because of deeper waters the tidal forces are unable to resuspend and bring the sediments to the surface. Also, tidal forces become weak with increasing distance from the shore. This may account for the sudden change in color from brown sediments to dark blue ocean

water in the satellite images, rather than the sediments gradually dispersing out into the Andaman Sea (see Figure 2 (b) and (c)). Just before and after the neap tide, when the turbid area is close to minimum and enough light is penetrating in the seawater, it is speculated that the primary productivity of the gulf will be very high and therefore a large fish population is expected (Ramaswamy et al., 2008; Ramaswamy et al., 2004).

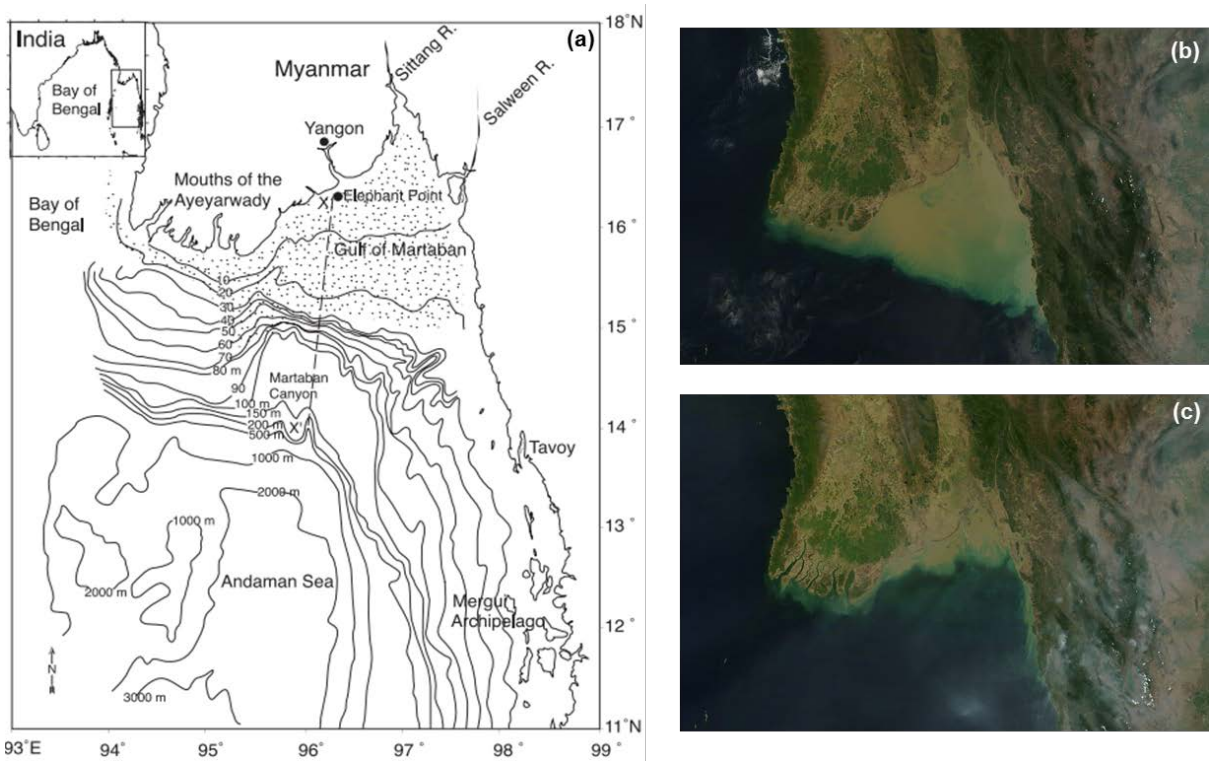


Figure 2 Bathymetry and satellite images of the northern Andaman Sea and Gulf of Mottama.
(a) bathymetric characteristics;
(b) maximum extent of the turbidity front during spring tide of 3 March 2014; and
(c) minimum extent of the turbidity front during neap tide of 12 March 2014.
Source: Courtesy of the NASA Land Processes Distributed Active Archive Center (LP DAAC), USGS/Earth Resources Observation and Science (EROS) Center, Sioux Falls, SD.

2.3 Biodiversity and ecosystems

There have been limited studies on biodiversity, historical changes and current state of resources and ecosystem functioning of the GoM. Yet it is identified as the most extensive and the most significant for shorebirds, fish and other biodiversity, amongst seven major intertidal mudflat systems in Myanmar (Zöckler, Delany, & Barber, 2003). It is reportedly productive ecosystem both on- and offshore, and as a result, sustains coastal population and agricultural productivity. It is not clear whether and to what extent the coast was previously home to mangroves or other native vegetation. Information from academics and Department of Fisheries (DoF) suggests that the western (Bago and Yangon Regions) side of the gulf has never had extensive areas of mangrove forests (although anecdotal evidence from

long-term residents indicates that the area was once heavily forested). Remnants of extensive mangrove forests can be seen on the eastern (Mon State) side of the gulf. It is possible that mangrove trees all around the gulf including Mawlamyine were overexploited to meet high demand for fuel wood and charcoal production from Yangon, and continued to degrade due to excessive expansion of rice production. According to academics, only *Avicenia spp and Nypa spp* are found along the coast of Mon State (San Tha Tun, personal communication, 2015). More research is needed to better understand the interrelation between mangrove development/disappearance and influence of spring tides in the gulf in terms of dynamics of substrates, and patterns of erosion and deposition.

The GoM has been recognized for the world's largest remaining population of wintering Spoon-billed sandpiper (*Eurynorhynchus pygmeus*) shorebird that breed in northern Asia and Alaska and spend the non-breeding season in Southeast Asia and Australasia and was assessed as Critically Endangered in 2008 by BirdLife International for the IUCN Red List. Available evidence suggests that a combination of habitat loss at key feeding areas on migration and on the non-breeding grounds, and the killing of waders by people for food at these non-breeding sites in Southeast Asia are the most likely contributing causes for its declining population. Joint surveys of the GoM conducted from 2008 to 2011 by Biodiversity and Nature Conservation Association (BANCA) and BirdLife International indicate that the gulf supports over 150 spoon-billed sandpipers, and more than 36 species of shore birds (150-200,000 individuals) including the globally endangered Nordmann's Greenshank and roosting Bar-headed geese among many others (Pyae Phyo Aung, personal communication, 2015).

To protect this key wintering habitat for migratory waders and shorebirds, BANCA proposed the inclusion of particular 80,000 acres in Kyaikto and Bilin Townships, where the birds winter, to the list of Wetlands of International Importance in 2011. The Ministry of Environmental Conservation and Forestry (MOECAF) recognizes the importance of large estuaries to the Spoon-billed sandpiper and other species; therefore, proposed to designate the GoM as a Ramsar site, giving it international protection and helping to prevent subsistence hunting of waders. To ensure the protection of this bird species and the many other species of waders that use, feed and breed on this important estuary, further research and long-term monitoring of the species is needed (www.eaaflyway.net; www.bto.org; and World Birdwatch magazine, March 2011). Although there is limited scientific data, anecdotal evidence suggests that the gulf supports marine wildlife like Finless porpoise (*Neophocaena phocaenoides*) which is ranked as Vulnerable in the IUCN Red List. Like in other countries in Asia, the Finless porpoise population in Myanmar is affected by habitat loss and degradation, entanglement in fishing gears, boat traffic and pollution. Further assessments are required to verify this information before population trend can be estimated and conservation measures can be made accordingly.

2.3 Socio-economic characteristics

Little information has been documented regarding demographics and socio-economic characteristics of coastal communities in the GoM. According to previous studies, population numbers in coastal villages often fluctuate, and are heavily influenced by sedimentation and coastal erosion. People tend to out-migrate from eroded areas – move landward or to other villages, and in-migrate to areas where accretion takes place. A number of residents move according to available resources and in seek for work opportunities. The majority of land in each township is occupied by farming – only a small proportion of those situated from between 2-5 km from the coast is defined by township officers as '*coastal villages*' (SDC mission survey, 2014). The proportion of fisher and farmer households varies in each state or region, with greater share of fisheries-dependent households in Mon State, followed by Yangon and Bago. Ongoing livelihood assessments conducted by Helvetas, should provide better understanding and basis on census, livelihood activities, resource use pattern, market value chains and basic infrastructure needs.

2.4 Prospective Ramsar site: International recognition of the GoM

The government ratified the Ramsar Convention in March 2005 and designated the Moyingyi Wetland Wildlife Sanctuary as the first Ramsar site in the country. With support from local and international development partners, MOECAF is currently a focal point in working toward designating the GoM area under the Ramsar international convention for the protection of wetlands. In line with the emphasis on social forestry and public participation outlined in the new Forestry Policy, the MOECAF Minister stipulated that the proposed GoM Ramsar Site be managed through a multiple-use and community-based approach. This ministerial directive creates an opportunity for local and international development partners to support coastal communities, local government agencies and the private sector to work together toward the sustainable and locally-driven governance of the natural resources of the gulf, with an emphasis on productive local livelihoods (Myanmar Times, vol. 716, February 10-16, 2014). Bird watching trainings and monitoring trainings for local conservation groups and former bird hunters supported by BANCA play an important role in reducing threats from hunting to spoon-billed sandpiper and promote bird conservation activities in the GoM. Recently, MOECAF has signed on as a government partner in the Flyway Partnership, and is likely to initiate the process for designation of the gulf as an East Asian-Australasian Flyway (EAAF) site. This could be complementary to Ramsar designation and can serve to strengthen the awareness of the international value attributed to the GoM.

3. METHODS AND SCHEDULE

The focus of this study and criteria for village selection was on fisher villages with a significant part of the population involved in fishing activities. As the itinerary below presents, the rapid socio-ecological assessment was conducted from 6-10 June 2015, and field survey was planned with support by preliminary information obtained from previous studies on biodiversity and fisheries in the area and through discussion with Mon State DoF officials; Dr San Tha Tun from Marine Science Department, Mawlamyine University; and Ms Myat Myat Win from Helvetas. The team[2] attempted to visit as many villages as possible, with different profiles and population numbers, in order to acquire a better idea of the situation at community-level. The assessment of minimum of two coastal villages in each state or region were expected

Date	Survey site			Accessibility	Activities
	Village	Township	State/Region		
6 June 2015	Six hour drive from Yangon to Mawlamyine. Meeting with: Dr San Tha Tun and Thet Htwe Aung from Mawlamyine University; Myat Myat Win, Helvetas Southeast Project Manager; and Mon State DoF officer.			car	Meeting with key informants and preparation of field survey.
7 June 2015	1. Ahlat	Paung	Mon State	car, motorbike	Personal observation and interviews with villagers, fishermen, and fish buyer.
	2. Aung Kan Thar	Thaton	Mon State	car, boat	Personal observation and interviews.
8 June 2015	1. Zotkali	Bilin	Mon State	car	Personal observation and interviews.
	2. Kyaik Kathar	Kyaikto	Mon State	car	Personal observation and interviews.
9 June 2015	Thone Htout Chune	Kahyan	Yangon Region	car	Personal observation and interviews.
10 June 2015	Two hour drive to Yangon.			car	Meeting with Pyae Phyo Aung, BANCA Program Manager/Joint Secretary

[2]The team consisted of IUCN staff Petch Manopawitr and Thu Zin Myo and consultants James True and Panwad Wongthong.

A range of data collection techniques were used, including key-actor interviews, village visits and group discussion. Informants at village level include small-scale fishers, fish buyers/collectors, shellfish harvesters, wage labors and women and young adults. Unstructured and semi-structured questions were conducted by team members, notes were taking and images were recorded during the field survey. It is important to note that some bias in the selection procedure may have occurred due to: (i) the dependence on high tide, weather and road condition to access the village; and (ii) the availability of villagers to speak to the team at relatively short notice. Given the existing limitations, it was difficult to survey all pre-planned study sites. Of a total of five days, six villages were surveyed: four in Mon State, one in Bago Region and one in Yangon Region. The study provides better understanding of biophysical characteristics, livelihood dependency, resource use and status of fisheries of the area. However, considering the complexity of extensive mudflats and intertidal zones of the GoM, findings from this scoping study does not demonstrate a detailed livelihood assessment of the gulf as a whole, rather serves as preliminary basis for socio-economic assessment and for developing a framework for long-term fisheries assessment and ecological monitoring as well as measures to promote sustainable livelihoods in the region. Results from the study can be used to form ideas and design questionnaires for future interviews.

4. RESULTS FROM THE SURVEY

4.1 Ahlat village

Location

Ahlat village is in Paung Township, Thaton District, Mon State. The village is well set up on the coast where Thanlyin River discharges into the sea.

Basic information

The village was established over 100 years ago. There are about 500 households residing in the area. Main livelihood activities are fishing and farming, with higher proportion being involved in fisheries.

General observation

The village is accessible by cars and motorcycles. Roads are mostly paved and well maintained. Vast area of paddy fields could be observed extending from the main road to the shoreline. Very few species of mangroves and its associates were spotted although the site visited is situated along the bank of the complex Thanlyin systems. According to the villagers, the village was once located much further in the

sea. Due to high tide and unstable land, people had no option but to move upland to less affected areas. We spotted abandoned well and several exposing palm and coconut tree roots demonstrating the extent of erosion and marking the level of land in previous time. An estimated 80-100 cm height of land was eroded in the past 25 years. A number of in-migrants returned to their town of origins while locals remained and adjusted to the change. As the research team visited the area during low tide, extensive mud flat was apparent. The sandy mud extends at least 5 km from the shore allowing fishermen to set up series of tidal traps or bag nets for their livelihoods and income generation.

Figure 2. A snapshot of Ahlat village demonstrating socio-ecological systems, fisheries and livelihoods.

Fishing activities

In other seasons fishermen go out at sea and bring in dried fish products after 15 days. However, in rainy season fishing cycle lasts only 8 days and ice is used to store fish catch. There are three buyers in the villages. Fish products are sold locally to the buyers and delivered directly to three companies based in Mawlamyine for onward sales in China. Belangeri croaker is reported to be caught all year round and one of the most economically important species in this area. One of the buyers informed us that Toil shad also give great profits to local fishing communities during summer seasons. A variety of fishing gears such as purse seine, set net and driftnet are reportedly used. On the mudflat, wooden structures for setting bag nets are evident. These nets are known to trap multispecies and all sizes of

fish and prawns. Nets are set during low tide and catch is collected after high tide. Marketable size fishes are sold in mixed catch at 5,000 kyat/viss (1 viss = 1.6 kg); whereas, small fish and prawns provides no market values. Parts of these products are sold locally for duck feed for 200 kyat/viss. Notably, bivalve collection was not commonly seen during the visit. This may be associated with stock depletion or unsuitable habitat. Collection of bivalve is not practiced in addition to near-shore or offshore fisheries, rather serves as main income for the families. In the past when the productivity was high, boiled meat was sold in markets in Mawlamyine. Nowadays, only two viss of meat can be harvested per person per day. On average, a bivalve collector earns about US$8 per day.

Other livelihoods/ income generation

Apart from the 100 families who own fishing boats, other residents are dependent on agriculture including rice paddies, home-grown vegetables and animal husbandry (mainly ducks). Ducks are marketed. Cattle are raised for farming or plowing while pigs and goats are for domestic consumption.

Perceptions and attitudes of resources condition

Interviews with residents, fishermen and fish buyers indicate that they recognize fishery resources depletion in terms of quantity, size and number of species. One buyer reported a sharp decline of fish products sold to him, from 30-40 ice boxes (1 box = 50 viss) per day last year to 4-5 boxes per day this year. It is difficult for fishermen to cover fishing costs and make enough profits to support their families. A number of boat owners as well as workers left fisheries sector for construction and manual laborers in Thailand and China. Along with the decline in fishery resources, residents also reported a depleted number of spoon-billed sandpipers over the past few years. Based on the interviews, residents are aware of the conservation program for spoon-billed sandpiper. Besides a stranding record of whale in 2004-2005, they do not recall spotting cetacean or sea turtles.

4.2 Aung Kan Thar village

Location

Aung Kan Thar village is in Thaton Township, Thaton District, Mon State. The community is relatively scattered – homes are built not far from the main road; in the surrounding of paddy fields; on the canal bank; and very close to the shoreline. Boat via a (presumably man-made) canal is the only mode of transportation to access the fishing community.

Basic information

It was reported that the village was established over 50 years ago. There are about 150 households and the majority of them are dependent upon fisheries for their livelihoods.

Figure 3 A snapshot of Aung Kan Thar village demonstrating socio-ecological systems, fisheries and livelihoods.

General observation

The research team transferred into a passenger boat where the unpaved road terminates. Small fishing boats and a few passenger boats were observed in the canal. Nearly all of the passengers were women who traveled to sale their fishery products and bought food and household utensils from the market. It took over an hour boat ride to reach the fishing community on the coast. The rather straight canal is influenced by tide and mainly used for transportation – no fishing activities seen during the visit. A water level control structure built in 2001 helps maintaining optimal level of water in the canal. Freshwater is obtained from rain harvesting and man-made ponds. It was reported that residents usually take bath in the sea and rinse themselves with freshwater afterwards. Not all residents sanitize water from the pond before consuming it. This is due partly to high cost of firewood and charcoal and limited knowledge in sanitization.

Fishing activities

Belangeri croaker seems to be the main economic fish in this village. Fresh products are sold to local buyers at 4,000 kyat/viss. Generally, market price for this species is higher in Mawlamyine if fish contain bladders. The research team visited one of the local buyers house. Various size of croakers stored in ice boxes were observed. Bladders were being removed from the fish by the buyer and his wife. According to them, dried bladders cost 80,000 kyat/viss in Yangon. Given such high profit, the couple prefer to sale them at lower price in Mawlamyine and concentrate on demand for dried bladders from China. Local fishermen mainly use set net, drift net and purse seine for fishing. Fishermen from nearby village identified mud crabs as another marketable resource available in the area. We encountered a group of fishermen unloading their six-day catch from a fishing boat. Crabs were harvested from island about an hour drive from Aung Kan Thar. At least 12 baskets (1 basket = 20 viss) of crabs were noted. Mud crabs are sold at US$100 per basket, so a total of at least US$1,200.

Other livelihoods/ income generation

A number of residents own paddy fields and depend on agriculture for their livelihoods. Some derive the majority of their income from fishing and rely upon gardening and animal husbandry for their subsistence. Home grown pineapple, banana, jackfruits and a variety of vegetables were apparent.

Perceptions and attitudes of resources condition

Interviews with key informants suggest that residents recognize dramatic change in resource condition. They reported a sharp decline in fishery resources. Fishermen showed concern over reduced catch. Fish buyer, once earned 100 viss of fish per day, is now struggling to get 40 viss after two days. They believed it is because of an increased number of fishermen and the use of fine mesh size fishing nets. According to them, the main competitor over fishery resources in nearby fishing grounds is Kyaikto fishermen. They noted small mesh nets used and huge pile of discarded fish on the shore caused by those fishers. Kyaikto fishermen was reported to weep all sizes and juveniles fish out of the sea but select only marketable size fish and dump the remaining on the shore, leaving behind unpleasant odor and empty sea for Aung Kan Thar fishermen.

4.3 Zot Ka Li village

Location

Zotkali village is in Bilin Township, Thaton District, Mon State. The village is situated on the west bank of the Sittaung River where it meets a nearby tributary and discharge into the sea.

Basic information

There are over 300 households in the village, approximately 90 of which are fishermen. The village was established very long time ago. The insurgent 60 years ago left some damage to many houses and resulted in out-migration.

Figure 4 A snapshot of Zot Ka Li village demonstrating socio-ecological systems, fisheries and livelihoods.

General observation

The village is well set up, roads are unpaved however well maintained, clean and tidy. House compounds are spacious and surrounded by trees and a diversity of vegetable crops. Residents depend on wells and rain for their freshwater supply. Generators and solar power are easily noticed. A few fishing boats were seen abandoned along the canal and in the intertidal zone due mainly to the loss in fishing and high labor cost. The existence of pagoda demonstrates Buddhism influence in the village. There is no remaining of mangroves and its associates along the journey from the main road to the shoreline. Very limited number of waders was observed and no sighting of dolphins or sea turtles has been recorded.

Fishing activities

Small scaled fishermen share their fishing grounds in the estuaries near shore while others travel up to 70 miles offshore. Fishers with small boats use small (1.5-2 cm) mesh nets to catch fish in the river mouth during high tides. With more efforts, fishers get an average of two viss of fish after two tides, making less than 2,000 kyat per day. Compared to 10 years ago, 10 viss of fish were caught just after two hours. The reduced catch has however little effect on their income as market price becomes relatively higher. The research team observed a few fishermen returning to the village with fish containers. The containers were about 20 cm length x 10 cm width x 20 cm height, indicating small size and small amount of catch. Multispecies of juveniles were brought back after two hour effort. Offshore fishers were reportedly using about 3 inch mesh size purse seine as their main fishing gear. In the mudflat, tidal traps or set bag nets are widely practiced. Unlike in Ahlat and Aung Kan Thar, no key economic species was identified. Fish products are sold in mixed catch – small size to local buyers and large size to company buyers either in Yangon or Mawlamyine. During the visit to a company buyer, female reproductive baramandi was spotted. According to him, June-July is the hatching time for this species and September-October is when larger baramandi (10 viss weight per fish) can be expected. On average he gets up to 10 ice boxes per day. But compared to 2009 when he started the business the quantity is only one-third.

Other livelihoods/ income generation

In addition to catch fisheries, residents are dependent upon terrestrial resources. No culture fisheries is practiced or ever been introduced – neither freshwater nor saltwater. Seasonal crop cultivations such as bean are planted on alluvial area and canal bottom during dry seasons. Mango, jackfruit, palms, coconut and home garden vegetables are commonly grown in their backyards.

Perceptions and attitudes of resources condition

Fishery resources have apparently been in sharp decline during the past few years. Residents including fishermen and buyers believed this are caused by a few reasons. An increasing number of fishermen especially from Kyaikto is the major factor contributing to the lower catch in the area. Kyaikto fishermen are locally known to use very fine mesh size nets with a length of at least 500 m fishing down all sizes of fish and prawns in their river mouth systems. Those fishermen select optimal size of fish and discard the small and juvenile fish, leaving the piles of unwanted fish and prawns to the locals to handle. The villagers once reported the incident to the DoF officials in Kyaikto. Even though officers visited the site and inspected the boats, gears and fishing practices, no illegal activity or prohibited gears were found. Some residents believed the illegal fishermen from Kyaikto had political connection with the line officers and were aware of the inspection. This has resulted in mistrust in the transparency of government

particularly in enforcement of fisheries. Local fishermen seemed to worry about the future but have no knowledge of the solutions. Considering more effort but low gain in fisheries, great number of fishing boat owners have experienced shortage of labors. Approximately half of boat owners abandoned their boats over the past years, workers left the village and shifted to manual labor in the farms or factories in Thailand and China. Some fishermen identified Cyclone Nargis as the cause of change in the ocean current, tidal movement, fish habitats and etc. Climate change related events on agricultural sector such as low precipitation in rainy seasons and salt intrusion in summer seasons is a great concern. The alarming rate of riverbank and coastal erosion over the last year has brought additional worries to the community.

4.4 Kyaik Ka Thar village

Location

Kyaik Kathar village is in Kyaikto Township in Mon State. The village is situated on the bank of the Sittaung River. The community is relatively scattered – many households are among paddy fields, some live on stable land near the pagoda and surrounded by fruit trees while the minority live on the erosion prone areas near the river.

Basic information

The village was set up long time ago. However, settlements built close to the bank now move landward due to river bank erosion and unstable land. Over half of the residents depend on fisheries for their livelihoods.

General observation

Houses are constructed of basic materials available in the area such as bamboo, palm leaves and poles. Freshwater is available through wells and rain harvest. Most houses possess at least two rainwater harvesting tanks. No garbage bin or common area for solid waste management was regarded - basic household requirements, paper and plastic bottles were thrown in the public space. Cattles and pigs were seen feeding on some discarded vegetables. Compared to other villages visited, there is more variety of vegetables in the stores, indicating greater engagement in home garden vegetables and higher dependence on terrestrial resources. Massive paddy fields are apparent and even extend to the shoreline. Basic mud/clay dike was made and maintained to reduce erosion and prevent saltwater intrusion into the rice fields. No native vegetation or mangroves was noticed.

Figure 5 A snapshot of Kyaik Ka Thar village demonstrating socio-ecological systems, fisheries and livelihoods.

Fishing activities

Many small-scale fishermen are engaged in freshwater and estuary fishing. Fishing nets set across the stream extending from one side to the other of the river are commonly practiced in this area. The nets are of 80 feet depth and are usually left for six hours to trap multiple species and various sizes of fish and prawns. Fishermen with larger boats take 6-7 day fishing trip offshore. There are six workers on the boat making about US$1,000 per trip from 100-200 viss of catch. Toli shad, Belangeri croaker and river prawns are the most common catch. According to the fishermen we encountered, juvenile Belangeri croaker is worth 7,000 kyat/viss; Shad 14,000 kyat/viss; and river prawns 10,000 kyat/viss. Fish can be sold in higher price when they contain bladders. It was unlikely that local fishermen have knowledge of any potential for aquaculture in the area. Awareness and understanding of culture of oysters, mussels, clams, or cockles seemed inexistent.

Other livelihoods/ income generation

There are several betel leave cultivation plots along the local roads. Fruit orchards, palms, vegetable crops, water crest, cabbage, tomato, guard and many more are seen around the houses as well as in

the backyards. In addition to fisheries, residents in Kyaik Ka Thar rely on agriculture and animal husbandry for their subsistence.

Perceptions and attitudes of resources condition

Interviews suggest that fishermen have been facing a decline in fish catch over the past ten years. In previous time they could catch 150 viss but now they only get 15 viss in 5-6 hours. Fishermen understand that the more effort they put the greater catch they make. They travel longer distance and spend longer time fishing at sea. Amount of ice on the boat determines how far they can go. An increase number of fishermen is thought to be the major cause of fishery resources depletion.

In the morning of Tuesday 9 June 2015, the research team visited a village in Kawa Township, Bago District, East Bago Region. We had a meeting with government officers at DoF provincial office. Since the office has recently opened in October 2014, there has been very limited historical or updated information regarding inshore and offshore fisheries. Officers work focus mainly on inland area - freshwater fisheries and agriculture. The team intended to visit nearby fishing villages in the region. Unfortunately the sites were tidal influenced and not accessible by car. Given the time constraint and a schedule to another village before sunset, it was not possible to conduct interview or personal observation in Bago Region.

4.5Thone Htout Chune village

Location

Thone Htout Chune village is in Khayan Township in Yangon Region. The village is situated in the area heavily influenced by Yangon River and a stream running from Thongwa.

Basic information

There are over 300 households in the village scattering along the main road and paddy fields, 50 of which live very close to the shore. Although vulnerable to wind, wave and erosion, residents moved to this area because of the easy accessibility to the sea and existence of freshwater pond (which has recently dried out). Freshwater is harvested from the rain; electricity is from generators and/or solar panels provided by the Department of Rural Development.

Figure 6 A snapshot of Thone Htout Chune village demonstrating socio-ecological systems, fisheries and livelihoods.

General observation

Part of this village was set up in very muddy area which is prone to flood and erosion. A government officer from Administrative Department from a neighboring city who once visited the village 40 years ago indicated that there was forest coverage in this area in which he also remembered seeing wild boars. Forests were clear cut for charcoal production and conversion to rice fields. It was not confirmed whether existence of mangrove forest was included in his memory. Interviews with villagers living near the shoreline indicate that area now in the sea was once (about 20 years ago) occupied by settlements, monastery and other infrastructure. The homes and buildings were collapsed into the sea, forcing villagers to move landward. Currently about 50 households (who possess no property upland) are at risk and expose to coastal erosion. In the past 5 years about 10-15 feet was lost seaward as rising sea erode the coastline. Since the dune has been rather stable from the last two years, villagers expressed no serious concern over the dynamic shoreline movement.

Fishing activities

Because of heavy rain, strong wind and wave in rainy season, there is usually no fishing activity around this area. Residents pay attention to gardening and animal raising – some derive their income from

livestock but some only care for subsistence. Small-scale fishers fish near shore using traps while fishers with larger boats spend 10 days out at sea. The fishing ground is about 4-5 hour drive. Everyday small boats will transport products from the fishing boat back to the mainland. Between October-November when they earn most profits, 5-6 baskets of catch (1 basket = 15 viss) are expected. Dried fish appeared to be common products sold in the market.

Other livelihoods/ income generation

Surrounded by paddy fields, proper and well maintained enclosures for ducks were seen in integration with fish ponds. Closer to the shore, pigs and goats were raised partly in closure, ducks were hardly observed in open area. It was common to see fruit trees and vegetable crops around houses near paddy fields; however, not many were noticed near the shoreline.

Perceptions and attitudes of resources condition

According to the informants, fishery resources have been decline over the past few years. The weather is unpredictable; impacts from strong wind, high wave and rising sea level associated with global climate change have become apparent. Mangroves once believed abundant are now disappeared leaving the shoreline unprotected. Villagers are concerned they would lose their homes and agricultural land because of continuing coastal erosion. However, this was not expected to happen in the very near future.

5. SUMMARY OF FINDINGS

Considering limited time allocated for data collection and small number of informants, it is rather difficult to generalize the findings from the survey. However, this rapid assessment offers a snapshot of the socio-ecological systems of the GoM including biophysical characteristics, coastal communities profile, fisheries and non-fisheries resource use patterns, perceived resource condition, as well as local attitudes toward fisheries regulation and management.

5.1 Characteristics of the GoM

The GoM is a tide-dominated mudflat with relatively small remnants of mangroves in the eastern side (Mon State). The inshore area is largely defined by mudflats and channels; the water is seldom more than a few metres deep, although seasonally large tides may cause changes of 4-5 m per cycle. The system is highly dynamic, with heavy erosion of the poorly-consolidated alluvium of the banks and water channels changing frequently. At low tide, the wide and muddy flats are frequently scoured by powerful tidal currents, and seasonally redistributed by floodwaters from the large rivers that feed into

the upper gulf. The profound influence of tidal flux on the poorly-consolidated fine sediments of the upper gulf structures the environment in ways that determine both the nature of the ecological resources and the methods used to exploit them. Prevailing ecosystems are largely dominated by soft-bottom, low-light benthos, and finfish that prey on them. Diversity amongst the finfish and invertebrate fauna appears to be quite low, although comprehensive surveys have not been undertaken.

5.2Coastal communities profile

Coastal population seems to fluctuate due to shoreline erosion, land accretion and changing condition of resources. Villagers tend to move landward, across to the other side of the river bank, to other township, or even to other countries like China and Thailand. Differences in house size, structure and materials indicate wide range of wealth within the same village. Basic houses are made of bamboo and nypa palm, with little or no gardens or surrounding land. Better-off residents reside in wooden or concrete house with corrugated iron sheet or tile roof, often with larger compounds, trees and gardens. Freshwater is obtained from rain, man-made ponds, and wells. Lakes and ponds are built through local initiatives but they either dry out, salty or muddy. Often the case individual household has to rely on rainwater harvesting facilities which are expensive and seem insufficient to their needs in dry seasons. Electricity is mostly from household generators. A large number of coastal villagers have at least primary school education. Pagodas and monasteries indicate strong influence of Buddhism. There is no health center in the visited villages, and those located in the township capitals are often difficult to access and limited to transportation.

High tide and powerful currents cause constant resuspension of sediments and exacerbate the erosional effects of over-clearing of vegetation. Channel banks are often high, undercut by erosion, and unstable. Bank collapses and salt-water incursions onto agricultural land and freshwater ponds are common. Shoreline stabilization measures are rare, only basic dikes made of mud exist in a few villages. Findings from the survey suggest that the majority of coastal communities are vulnerable to natural hazards and are in need of basic infrastructure like electricity, freshwater supply, water sanitization system, solid waste management, and drainage system during wet season.

5.3Fisheries and non-fisheries resource use patterns

Coastal communities of the GoM are largely dependent upon fisheries, followed by farming and wage labor. Local fishers predominantly work the river mouths and inshore areas, within sight of shore, using small boats and basic fishing gears (yet some are destructive). Those who do not possess boats earn

from being boat workers. Locals do not appear to engage in extensive aquaculture[3] or exploit resources for any but the most basic purposes (little secondary processing in evidence, and what product is not sold for cash is either consumed immediately or thrown to waste). Small-scale fisheries and fishery-related activities (e.g. net preparation, fish processing) are operated in dry season starting from mid-October to April or May. Despite rough weather in the monsoon season, commercial scale fisheries drive offshore and continue to benefit from large catch. There has been no record of aquaculture or mariculture along the coast of Mon State and eastern Bago Region. However, small-scale bivalve culture and traditional trap and hold technique are reportedly practiced in Thanatpin and some areas of Yangon Region. Little attention to cultured fisheries (aquaculture and mariculture) may also relate to limited skills and knowledge in aquaculture techniques, lack of capital and low support and encouragement from outside.

Most fisher families appeared to have access to small (<8 m) motorized vessels that could be crewed by 1-3 fishers. Fish market value chain in the gulf begins at fishers, carries on to collectors (either from the community or an agent from trading companies) and ends at larger trading companies and/or retailers in big cities like Mawlamyine and Yangon for onward sales overseas. It is common for large companies based in Mawlamyine and Yangon to have collecting centers in fishing villages and township capitals. Drying of larger fishes *in situ* by fishermen or chilling of fresh product (particularly economically important species like croaker, Toli shad and hilsa) in ice chests appeared to be the preferred methods of preservation. Fishers have very little influence in price setting and often are not aware of final market price in big cities. Although Thailand and Singapore are the second and third largest importing countries for Myanmar fishery products after China, only the trades to China was noted during this survey. Interviews with fishers and collectors suggest no target species in the GoM fisheries, but Belangeri croaker, Bombay duck, Sea catfish, Threadfin, Toli shad, sea bass, mullet and whiting, prawns and crabs were reported the most common species. Prices vary according to species, foreign currency rates and market demand and supply. Belangeri croaker make two distinctive values – high price if contain bladders and low price without bladders. The locals willingly sale the particular fish at lower price and trade dried bladders separately for high profits from Chinese markets. See table 1 for product processing and their market use.

Table 1 Common species caught in the GoM, their process and market demands.

[3]The instability of the mud banks upon which they build their villages may be part of the reason for this, since they expect the shoreline to change often, and are unwilling to deploy infrastructure where it may be unrecoverable. That being said, however, there appears to be little interest in freshwater pond aquaculture, despite its commonness around villages only slightly inland. The strong self-identification as "fisher folk" may limit the ability of the local villagers to think laterally about alternative incomes or industry.

Type of fish	Local name	Process	Use/ market
Belangeri croaker (*Johnius belangerii*)		Iced	Export to China
		Dried bladders	Export to China
Bombay Duck (*Neophocaena phocaenoides*)	NgaHnat	Dried and salted	Local consumption
Sea catfish (*Arius thalassinus*)	NgaNyaung	Fresh and dried	Local consumption
Threadfin (*Polynemusindicus*)	Kut Ku Yan	Dried	
Toli shad (*Tenualosatoli*)	ThaLaukUaukPha/ Par Mae	Iced	National markets and export
Hilsa shad (*Tenualosailisha*)	NgaThaLauk	Iced	National markets and export
Seabass (*Latescalcarifer*)	KaKaDit	Iced	Export
Mullet (*Liza parsia*)	Kut Be Lu	Fresh	Local consumption
Whiting (*Sillagosp*)	Nga PaLway	Fresh	Local consumption

Non-fisheries resource dependency includes rice production, crop farming, animal raising and fuel wood collection. Fuel wood collection for domestic use and small-scale animal husbandry are practiced all year round, while rice production takes place in wet season (April-November) and other farming activities including legumes are cultivated in dry season (December-March). Most fishers who reside close to the shoreline do not have land to cultivate. These households have difficulty meeting their daily needs during wet season because of limited work available in fisheries sectors. This has resulted in heavy dependence on wealthier families who own land or boat for wage labor. Some of the poor migrate or seasonally migrate to Thailand and China for manual labor jobs in factories and farms. Some put more efforts (including applying illegal practices) on their resource harvesting.

Rice is the main cultivation in the GOM. Productivity varies depending on various factors such as seed quality, agricultural technique, salinity and water irrigation. Other crops include beans, ground nuts, beetle leaves, etc. Weaving and pottery were also observed during the survey. Poultry (mostly ducks), pigs and goats are raised as extra income and for supporting food security. Cattle are used for farming purposes especially plowing and hoeing, and transporting farm products between fields and homes. Houses situated close to or surrounded by rice paddy fields seem to be better-off as compared to those near the shoreline. The characters of the house are a wooden structure raised on posts, very large verandah area, parallel roofing and steep roofing. Shrine is seen prominently placed at the living room in almost every house. The compound is fenced by big trees with large space and a corner for tube well, storage tank, and bath area.

5.4 Perceptions of resource condition

This rapid assessment was conducted in coastal villages, and therefore mainly considered small-scale inshore fisheries. It is difficult to provide information on monetary values of fisheries and historical trend of fish stock in the GoM. However, the interviews demonstrate that coastal communities depending on fisheries recognize changes of fishery resource condition over time in terms of catch, fish size and species variation. The catch was reportedly decreased over 50% (even 80% at some places) in the past 5-10 years, with a drastic decline over the past year. Overuse of very fine mesh nets, heavy exploitation by commercial fishers and apparent disregard for sustainability are major reasons contributing to the depletion of fishery resources. Interestingly, no demand for fishmeal production in the areas around the gulf was reported (unlike in the Myeik Archipelago and areas close to Thai border) which means that fisheries in the gulf are unlikely driven by such markets. This provides great potential and opportunity to implement restriction on fishing gears and practices. Since fishery resources persistently declines and fishing costs become higher, about half of fishermen and boat owners abandoned their business. Impacts are evident on local livelihood, reflecting in lower income for stakeholders directly involved in fisheries (i.e. fishers, traders and processors) and those indirectly participating in fishery trade (e.g. ice-makers, truck drivers and fishing gear sellers/makers).

Local fishers accept some of the blame to themselves, but principally blaming commercial fishers and fishers from neighboring townships who use inappropriately efficient gear but discard and destroy the non-commercial fraction (comprised in large proportion of juveniles of commercial species) of their catch, rather than use more sustainable methods. To cope with the unfavorable situation, fishers put more effort in fishing activities, and this involves longer hours at sea, further distance from shore, and use of small-mesh size fishing nets. These local fishers appeared to understand the linkage between overfishing of juveniles and depletion of biomass, but felt they had few alternatives other than to adopt unsustainable practices if they wished to maintain a fisheries-based lifestyle.

5.5 Attitudes toward fisheries regulation and management

Based on the survey, coastal communities of the GoM are aware that DoF is the regulatory authority for dealing with fisheries, and they acknowledge that fishing activity in Myanmar is controlled by a licensing and registration system designed to control both vessel and gear types. Inshore fishers or people intending to collect marine products for sale are required to have a license from the DoF officers of respective township. Yet, there are neither individual transferable quotas (IQTs) nor total allowable catch (TAC) regulations in Myanmar's fisheries industry. Seasonal closure has been implemented to allow unimpeded spawning and recruitment for several economically important species, circumventing

the impacts of fishing on spawning aggregations and the removal of gravid females from the spawning stock. However, effective compliance and enforcement is questionable.

Local fishers identified a lack of compliance, as well as ineffective law enforcement (involving corruption among responsible agencies) major reasons contributing to the sharp decline in fish stock. They reported conflicts over fishing ground with fishers from neighboring township. Past experience has resulted in mistrust in the enforcement authority. They suspect that illegal fishers have some personal or political connection with the government officers, and they are certain that corruption is involved in the enforcement of fisheries. The groups of fishers we encountered showed interest and enthusiasm in initiating and developing governance of fisheries at community level. They believed community groups can help prevent electric fishing, poison fishing and the use of fine mesh size by neighboring fishermen. One of the important findings is that local fisheries are often of small-scale, but not necessarily mean for subsistence or sustainable. Cumulative effects of removing juvenile fish and small economic fish by the use of small-mesh fishing nets, multiplied by impacts from offshore fisheries can cause irreversible consequences to fisheries in the entire gulf.

6. RECOMMENDED ACTIONS

The fisheries underway in the upper GoM observed by the survey team could not be categorized as “subsistence” fishing. For the most part, fishers attempted to catch commercial quantities of product for sale to middlemen; consumption of fish was not regarded as a principal source of protein by the villagers, but rather as a supplement. The products obtained via the fine mesh barrage nets (mostly juvenile fishes and crustaceans) were not highly regarded and was sold as food for ducks or even discarded on shore. The fishing practices of the local villagers, boat owners and commercial fishers appear to be unsustainable on the scale they are undertaken and have resulted in the virtual collapse of fisheries resources in the gulf. The current state of fishery in the gulf has passed through the “controlled” phase, and has clearly entered a Malthusian rush to extinction of the resource. Education of the local fishers to understand the linkages between their activities and resource sustainability is important, but will not greatly affect their activities unless reliable alternative livelihoods are promoted. Recovery is possible if the area is given some respite from the rampant overfishing of juveniles, but this will require genuine cooperation from the larger commercial interests across divisional boundaries, and much more pro-active enforcement of existing fisheries legislation. Based on this rapid socio-ecological assessment, recommended actions are as follow.

6.1 Establishment of baseline fisheries information

Despite the acknowledgement of alarming decline of the GoM fish stocks by all stakeholders, it has been difficult to access scientific information or baseline data on the rate of this decrease, the main species affected by overfishing, or the ecology of the species used by the fisheries, and how these species locally migrate and use the gulf during their life cycles. Little action can be undertaken without a certain level of background fisheries data (Table 2); unfortunately there is little extant information available. As identified by Ramaswamy (2004), the gulf is one of the poorly known areas of the world's ocean with very few research since the International Indian Ocean Expedition in the 1960s. As in many countries, Myanmar fishery data collection is overly-aggregated, poorly-distributed in time, and needs improvement in terms of important ecological and spatial information. To date, surveys by NGOs and academics have been limited in scope and range of data collected. Academic studies are likewise somewhat sparse; there are an unknown number of archived graduate theses related to fisheries resources in the gulf, but they are very limited in both scope and scale because of resource limitations. With current available data, it is difficult to create an *ongoing* monitoring plan or management action plan.

Table 2 Background information required to implement knowledge-based fisheries management.

	Item	Source	Existence	Required Investments
1	List of captured species	• DoF • Previous NGO studies	Partial Partial	• Academic input (fish/crustacean/mollusc taxonomists) • Creel surveys • Independent sampling
2	Ecological data of target species • Size range • Habitat requirements • Reproductive ecology • Capture rate at significant ages (+ stock structure)	• DoF • Previous NGO studies • Academic documents	Partial No Partial	• Academic input • Seasonal/annual studies of habitat use/ catch localities/catch composition
3	Spatial variation in capture fishery - techniques, gears, catch composition	• DoF • Previous NGO studies • Academic documents	Partial Partial Partial	• Academic input • Creel surveys • Fisher surveys
4	Socio-ecological study integrated with fisheries management data • Number of vessels involved in the fishery (of all types) • Number and types of gear being deployed (+ seasonal) • Reliance of fishers on the resource for income or food	• DoF • Previous NGO studies	Partial Partial	• Academic input • Fisher surveys • DoF input • NGO input

<u>Detailed description of each recommended action</u>

1. List of captured species

Although this is the default data set espoused by fisheries management agencies throughout the region, it is by no means a sufficient basis upon which to structure a sustainable fisheries management policy. It is, however, an essential component of any such policy, and forms the basis for any future development of capacity for managing the fishery. The most elegant solution to the immediate problem of resolving species identifications is to arrange a collaborative study involving the DoF and a university-based academic, with the emphasis on training a team of graduate students with fish- and invertebrate-identification skills to develop a cadre of skilled personnel. DoF records and skills can be mined to enhance the effectiveness of the academic training, and can provide a source of data for a meta-analysis of catch trends over time. This is also an excellent opportunity to engage overseas expertise in the study, since researchers interested in this type of ecosystem are likely to be enthusiastic participants in training workshops and field work.

- *Academic input* (fish/crustacean/mollusc taxonomists)→both training of field workers, and compilation of lists based on previous DoF, academic and NGO studies.
- *Creel surveys*→repeated visitation of researchers to landing sites throughout the region, encompassing different seasons, and different lunar periods (since catch ability of prey and effort by fishermen may vary according to lunar phase or tide periods).
- *Independent sampling*→employing either local fishers or a research vessel fitted with appropriate gear.

2. Ecological data of target species

This study is an extension of *Independent Sampling* above, with the addition of a multi-disciplinary ecology research group. The ecological aspects of the study will provide key insights into the potential resilience of the system and its potential for recovery once sustainable resource management practices are implemented, and are thus of great importance. The local academic resource base for this component is likely to be more robust than that for the purely fisheries study, since there has been a history of focus on the littoral margin of the coast. This component provides excellent opportunity for local academic participation and training, as well as outreach. It is important for the academic participants to recognize the value of local and traditional knowledge in this study, and the value of integrating this knowledge with a rigorous ecological understanding of processes. Integration of coastal and marine ecology is required to understand the role of critical habitats in the life cycles of key species, and so this section is possibly the most important to “get right” in a scientific sense.

- *Size range of captured species*→direct observation of captured animals, several times per year (to track age cohorts). This provides important ecological information about population

structure and the ontogenetic development of the resource, and the level of population depletion of the stock in a fisheries sense.

- *Habitat requirements* – particularly ontogenetic habitat shifts. This study requires a fairly high degree of investment, since the researchers must not only interview fishers to ascertain the capture locations of various size cohorts, but must independently validate these data using capture sampling, baited videos and traps in a variety of habitats throughout the year. A study such as this would reward heavy local and international academic input and would provide the basis for several higher degree studies.
- *Reproductive ecology* – seasonality and periodicity, and factors affecting recruitment. This is the cornerstone of fisheries management. Without insights into the dynamics of replenishment of depleted stocks, management is impossible and the resource is bound to fail. It should be undertaken by academic researchers in partnership with commercial enterprise groups and the DoF.

  The approach should be two-pronged: a) sampling from commercial landings, providing large samples of (notionally) reproductively mature individuals, supplementing information from logbooks detailing capture locations, depths and times; b) data and gonad samples from specimens obtained in subsection 2, above, provide detailed information about recruitment processes, rate and size of maturation, and sex ratio at different stages of the life cycle. Since much of the study requires extensive laboratory work (albeit very little actual infrastructure), the bulk of this study should be undertaken at the academic level, providing ample opportunities for graduate training and academic capacity development.
- *Capture rate at significant ages* (+stock structure)→identification of size clusters in the fisheries capture data can provide insights into inappropriate fisheries practices and vulnerabilities amongst particular age cohorts in the fishery. Differences in cohort structure can also indicate that the fishery is being replenished from outside the system, or conversely indicate especial vulnerabilities for isolated stocks that are not connected to external sources of replenishment.

3. Spatial (and temporal) variation in capture fishery

This study is pure fisheries science and serves as context for the fisheries ecology described in section 2, above. Although this has been the subject of several reports, they are one and all far too superficial to provide a real basis for managing the fishery. The reason for this is that they have not been integrated over a spatial or temporal scale. While the fishers themselves will readily discuss adaptations in gears and techniques for different habitats or times of the year, this has not been recognized as

significant in previous studies by any agency. That being said, the study itself is quite straightforward, requiring:

- Academic input;
- Creel surveys to identify changes in targeted or captured species composition;
- Fisher surveys and direct observation of techniques and gears deployed; and
- Historical data from DoF and previous academic/NGO studies.

4. Socio-ecological study integrated with fisheries management data

The core of this study is to establish the level of fishing pressure and the absolute reliance of local people on the existence of the fishery in its current form. It is clear from the published data that the fishery is in a fatal downward trajectory, and will not survive in its current form. This study requires that all of the fisheries data collection detailed in the above be integrated with socio-ecological studies to establish whether the local communities are resilient to strong changes in their livelihood sources. The scale of effort has (so far) been described poorly – in that the changes in fisheries practices and the level of effort have not been matched to either the level of ecological or social/economic stress experienced by the fishers or their communities. Seasonal variations in accessibility or resource availability are likely to cause shifts in emphasis, technique or level of reliance on fishing as a source of income for villagers. Likewise, ownership of a fishing vessel is likely to inform the level of dependency of the fisher on capture fisheries as a source of income, although ownership of multiple vessels places the "village fisher" in quite a different category. The relative reliance of fishers on captured product for either sustenance or income has been poorly described, and this data must be matched to the amount of effort being applied to the fishery by purely commercial enterprises to ascertain the total level of fishing pressure on different components of the resource.

This is not a purely academic study, although the integration of disparate data sources may lend itself to academic treatment. Input from extant data collection agencies (especially DoF), and NGOs already working in the region should be validated against independent assessment of both effort and gears deployed, on a seasonal basis.

6.2 Monitoring of the resources

Monitoring activity is very much a secondary priority in the context of the GoM fishery. Once a certain threshold of baseline ecological information is obtained, then monitoring becomes meaningful, in the sense that it is possible to use the monitoring data to detect improvements or further declines in the health of the resource. Without strong baseline data, "monitoring" is a waste of resources, and provides no meaningful information. In the context of this project, monitoring is mostly a continuation of

Background Data Section 2 (Ecological Data), above, supplemented by ongoing assessment and integration of information about the fishery itself. The study is quite straightforward, requiring: academic input (to train a cadre of skilled field workers); creel surveys to identify changes in targeted or captured species composition; fisher surveys and direct observation of techniques and gears deployed; and historical data from DoF and previous academic/NGO studies integrated with data from Section 2.

6.3 Ecosystem-based resource management policy development

Interest in ecosystem-based management in the marine realm has developed in response to increasing recognition of the declining state of fisheries and ocean ecosystems. To better manage fishery and coastal ecosystems in the GoM, it is important to consider the full array of interactions within an ecosystem, and incorporate biological, physical and human components, including social and economic systems. Good governance and effective laws and enforcement are principal requirement. The government has implemented a number of policies regulating fisheries and protecting marine environments. The effectiveness of policies implementation however depends mostly on the political will and the availability of resources to implement it. In the case of Myanmar, fisheries regulations mostly apply to offshore commercial fisheries; destructive and illegal activities by artisanal or small-scale fishers are often regarded inconsequential and of negligible scale. Apparent overexploitation of fishery resources, unsustainable fishing practices, disregard of sustainability and ineffective fisheries laws and enforcement have been widely recognized throughout the gulf. There are no regulations specifically developed at the state/region, township or village levels on the protection of key areas or key species regardless of all year-round or seasonal. Regular patrol and enforcement is nearly inexistent. It is unclear to local fishers to what authority should they report illegal activities and what authority enforces fisheries legislations. In response, clear roles and responsibilities are required, and fisheries governance and law enforcement information need to be made understandable to coastal communities. Since the gulf bounds with three state and regions where fishery resources are shared, it is difficult to address overfishing and illegal fishing issue by one state only. Implementation of a quota system and dialogues on fisheries and transboundary agreements between border regions and state should be taken into account. Lessons learned from FAO Myanmar experience on fishing rights and fisheries management in inland fisheries could be useful to plan freshwater fisheries management of the rivers of the gulf, as well as for inshore fisheries.

The act of designating a part of the GoM as Ramsar site is an appropriate first step along a conservation and sustainable use pathway. It provides an opportunity to affirm the commitment of central and state governments, and the cooperation between different states and regions, for the

sustainable management of the gulf. In parallel, platforms for communication and knowledge sharing among relevant authorities and development partners can be developed. Issues such as the impact of human activities on the ecological character of the wetland, the economic and socio-economic values of the site (especially for local communities), and the cultural values associated with the site must be considered. Since the prospective Ramsar site support wintering ground for Spoon-billed Sandpipers and a number of other shorebirds, there is a great potential for developing well-managed nature-based tourism which offers high earning and causes low impacts. Such tourism activity should however ensure involvement of local communities and equitable benefit sharing. Development activities upstream such as deforestation, mining, dam, effluent and pollution from manufacturing plants have influence on sediment and water quality flow into the gulf, and therefore, species conservation and fisheries management should consider broader management of watershed. Although this survey focused on inshore fisheries, offshore fisheries catching fish inshore have been reported, and thus should be included in the full scope of the fishery analysis in the gulf. In this context, there is apparent room for improvement in enforcement system and better cooperation with Navy and Myanmar Fisheries Federation (MFF) to ensure the sustainability of fisheries.

6.4 Community-driven governance of natural resources

The dynamics and complexity of the GoM has made fisheries enforcement more difficult for the line agencies. Governance of natural resources at community level should be developed in line with improved cooperation between regulatory and enforcement authorities. Local fishers who understand fisheries condition and challenges, and depend on fisheries for their subsistence and income should be given opportunity to actively participate in the management, monitoring and enforcement of resources. Local fishery cooperative or fisher association or community fisheries should be formed with support from the central and state/region government. Local communities may involve in patrolling systems and regulations of local resource use in forms of community regulated closure areas for fishing or for bivalve collection to allow regeneration, gear restrictions, etc. This formation will also allow local fishers to negotiate fair price for fishery products and manage savings for their families. Community-driven governance of resources should help filling the gaps in national capacity for fisheries enforcement. However, promoting the engagement of local communities in resource management and conservation reflects the needs to link action on the ground with better education and awareness, as well as a sense of ownership and responsibility for resources. Communities need to be empowered to allow meaningful partnership and sustaining outcome.

6.5Enhancing coastal community resilience through alternative livelihoods and risk reduction

To reduce pressure on fishery resources in the GoM, as well as enhance local community savings opportunities and ensure a continuous access to food sources, it is vital to diversify their livelihood portfolio. In this case, agriculture, including the cultivation of crops, the rearing of animals, and the farming of aquatic organisms, deserves greater support. Since rice is the main crop cultivated in the gulf, there is an opportunity to provide technical knowledge (e.g. soil preparation, seedling beds, seed election, rice planting and maintenance of rice crops) according to the problems and needs of the local farmers. This includes the distribution of equipment necessary for rice plantations (e.g. hand tractor, fertilizers). Support for animal husbandry involves trainings for better understanding of animal rearing techniques and diseases control. Distribution of equipment for building proper shelter and enclosure for livestock can be considered. A home garden (e.g. cucumber, string-bean, watermelon, water crest, pumpkin, wax melon, eggplant and chili) should also be encouraged. Given that fisheries are hardly predictable and over-exploited, cultured fishery is an attractive alternative to traditional catch fishery although it should be noted that this is not a part of the local habits. Well-managed small-scale bivalve culture, such as mussel, clams and cockles, and oysters, may be a good option because it requires low investment, simple techniques and low maintenance. Bivalves filter feed and make no demand for artificial diets or on fish meal; they can be cultured at very high densities at appropriate areas of high phytoplankton production and water quality conditions. Importantly, bivalves are predicted to continue to be a major component of global aquaculture production, presenting long-term potentials for income generation for the gulf communities.

Myanmar has fewer large dams relative to its neighbor countries. This is forecast to change in the next 5-10 years with extensive damming projects on the Thanlwin (Peter, Michael, & Ruth, 2010). The sediment retention may cause losses in sediment supply to the Gulf and further exacerbate the impacts of extreme events. Shoreline protection and stabilization is required so that the communities living on the GoM coast is protected. Implementing green infrastructure can be considered - with further studies to determine suitable methods for the gulf considering specific geophysical setting, cost reliability, and other factors. Options to take into consideration include mangrove revegetation and/or bamboo fencing as implemented in other Southeast Asian neighbors. Coastal protection and shoreline stabilization can be achieved through several approaches, which may be used in combination with each other. The green infrastructure should be designed to withstand and diminish the force of waves while also allowing water and animals to pass through, and also trap the silt deposited in the dry season and stop it from being washed away in the rainy season. Importantly, the natural infrastructure will function as habitat for marine species for protection, feeding and spawning. This approach is expected to provide

cost-effective risk reduction and also supports biodiversity conservation and enables improvement in economic livelihoods and well-being.

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